The drive for the spool is taken from the left hand end (as shown) of the crankshaft **154** via a belt **103** to a drive quill as shown diagrammatically in FIG. **13.** Also shown in FIG. **15** are integral eccentric discs **150, 151,** a sectioned part **152** of the yoke of the piston pair which reciprocate perpendicular to the plane of the paper, the crankpin **153** and the flywheel **155** secured to the crankshaft **154.**

Although the piston/yoke assembly of FIGS. **5** and **6** is shown in FIGS. **15** and **16,** it may be preferred to employ other types of assembly instead, e.g., that of FIG. **4,** or any of those of FIGS. **7** to **9.**

FIGS. **17** and **18** show typical applications of the machines of this invention as power units for automobiles.

Using good, orthodox design methods, the machines of the invention can have 60% of the specific volume of and considerably greater stiffness and lower prime cost than their conventional counterparts. Thus, a 4-cylinder 1.5 liter high speed gasoline engine of 92.3 mm. bore and 56 mm. stroke will have a cylinder block which can easily be accommodated in a 240 mm. (9 ½ inch) square to which must be added only the height of the cylinder heads. The crankshaft length need not exceed 128 mm. (5 inch). The small dimensions of the engine lend themselves well for use in the most advantageous designs of vehicle (low bonnet line or mid-body location). If more than one bank of pairs of cylinders (e.g. 8 cylinders in two banks) is desired, any couple resulting from crankpins 180° out of phase is completely eliminated by mirror-imaging.

The advantages and benefits of machines of the invention arc: (1) elimination of piston tilt and piston sealing problems; (2) reduction of number of stressed components; (3) elimination of secondary out-of-balance forces; (4) reduction in distance between crankshaft center-line and piston underside; (5) elimination of dynamic bending loads in the piston pairs; (6) increased crankshaft stiffness; (7) increased yoke stiffness in combination with optimized piston wear shim arrangement and lubrication to take up side thrust forces; and (8) lower manufacturing costs and reduction of specialized manufacturing processes. In addition, the improved combustion chamber shape combined with the rotary valve ensures unburned fuel pollutants, gas blow-by can be reduced by means of a blow-by belt, the pistons may be oil cooled, the shorter stiffer structure will minimize noise, and the tiltless pistons reduce oil consumption.

Although the machine of the invention has been described principally in its application to internal combustion engines, it will be clear to those skilled in the art that it may equally well be employed as a fluid pump or compressor, and in most other applications where a piston is conventionally connected to a crank by a connecting rod.

What is claimed is:

1. A machine comprising a frame, a crankshaft rotatably mounted in the frame, a plurality of pairs of cylinders integral with the frame, the cylinders in each pair being disposed on opposite sides of the axis of the crankshaft and each pair of cylinders being angularly and axially separated around the crankshaft axis, means for allowing fluid to pass into each cylinder at one pressure and for allowing fluid to pass out of each cylinder at another pressure, the crankshaft having one crankpin for each plurality of pairs of cylinders, each crankpin having an axis which is eccentric relative to the crankshaft axis, a plurality of discs equal in number to the number of pairs of cylinders and each disc being rotatably mounted on each crankpin between the cylinders of a respective cylinder pair with its geometric axis having an eccentricity relative to the crankpin axis equal to the eccentricity of the crankpin axis relative to the crankshaft axis, the geometric axis of the discs on each crankpin having a relative angular separation which is twice the relative angular separation of their respective cylinder pairs, adjacent discs being in contact with each other over areas bounded between their superimposed peripheries as viewed in directions parallel to the crankshaft axis and rigidly connected to each other within said areas whereby all the discs on a common crankpin rotate together, the periphery of each disc being adapted to take a bearing load, and each disc being received in a bearing aperture of a rigid yoke which extends perpendicularly to the crankshaft axis and symmetrically on both sides of the disc, there being in each cylinder a piston connected to each end of the yoke and the yoke being supported against side loads solely by cooperation of the piston with the cylinders at the ends of the yoke, the piston having a substantially fluid-tight seal with the respective cylinder and also includng a hard metal flexible bearing shim about the periphery of said piston and moving therewith, annular insert means engaging said piston disposed at opposite ends of said bearing shim to restrain axial movement of said shim on said piston, said bearing shim having an outside diameter larger than said piston and serving to act as essentailly the sole bearing member for adsorbing any side loads on the piston, by promoting the formation of a film of lubricant under pressure between the outer surface of the shim and the adjacent portion of the cylinder wall at relatively low piston speeds and forming said lubricant film to a wedge-shape (in axial cross section) with the wider end of the wedge facing the direction of movement of the piston at higher piston speeds, there being no gear or gear-train connection between any of the discs and any part of the frame or the crankshaft.

2. A machine according to claim **1** in which each disc is received in a plain bearing of the surrounding yoke.

3. A machine according to claim **1** in which each disc is formed from a light alloy and each yoke is formed from a light alloy, the plain bearing being an insert of thin sheet resilient metal of high wear resistance which is tightly received in a circular aperture of the yoke.

4. A machine according to claim **1** in which a plain bearing surface is provided between each crankpin and each disc.

5. A machine according to claim **1** in which each plurality of discs is formed from a single piece of metal.

6. A machine according to claim **1** in which there are provided two pairs of cylinders disposed perpendicularly to each other about the crankshaft axis on a common crankpin.

7. A machine according to claim **1** in which th yoke and pistons of each pair of pistons are formed in one piece.

8. A machine according to claim **1** adapted for the production of power by internal combustion in the cylinders, comprising means for supplying in turn to the cylinders the constituents of a conbustible air and fuel mixture, and means for leading combusted products out of the cylinders in turn.

9. A machine according to claim **1** comprising means for supplying a non-combustible pressurized fluid to